REMARKS / ARGUMENTS

In response to the Second Office Action of March 16, 2007, Applicants have amended the claims and presented remarks below to resolve concerns raised by the Examiner. Reconsideration and allowance of the specification and pending, amended claims are respectfully requested.

I. Invention Overview

The invention is a fuel cell stack that includes a reaction portion having an end cell secured adjacent to a current collector. The collector has a sensible heat no greater than a sensible heat of the end cell, that is less than 1.0 mm thick (as amended), and an electrical resistivity no greater than 100 micro-ohms centimeters. An insulator is secured adjacent the collector and has a thermal conductivity that is no greater than 0.100 Watts per meter per degree Kelvin and that is less than 20 mm thick (as amended). Because of the low sensible heat of the current collector and low rate of heat transfer of the insulator compared to the heat generation of the end cell, heat does not readily leave the end cell resulting in a rapid heating of the end cell. This avoids freezing and accumulation of product water in the end cell during start up in subfreezing ambient conditions.

II. Response to Office Action

This Response will address the concerns of the Examiner in the order in which they appear in the March 16, 2007 Second Office Action. First at Section 2 the Examiner rejected claims

23-24 because those claims "are not held to further limit the power plant of claim 22." By the present amendment, claims 23 and 24 have been amended to recite that the "fuel cell stack (10)" is secured in electrical communication with the components identified in claims 23 and 24, thereby further defining the claimed power plant of claim 22. Antecedent bases for these amendments are found in original claims 22-24.

Next, at Section 3 at the first and second paragraphs the Examiner has rejected all independent claims, claims 1, 22, and 25, under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,764,786 (hereinafter "Morrow") as evidenced by "ZIRCAR" Ceramics: ZAL-45 & ZAL-45 AA" and Handbook of Fuel Cells. The Examiner proceeds to meticulously compare structural characteristics of Morrow with the claimed components of independent claims 1, 22, and 25 between pages 3-7. In so doing the Examiner specifically reviews the electrical resistivity and/or conductivity of the current collector (pages 3-4); the thermal conductivity of the insulator (pages 4-5); and then, the thickness of the current collector, thickness of the insulator, thermal conductivity of the insulator, and "that the method [of claim 25] would rapidly warm the fuel cell…." (pages 5-7).

In her detailed observations supporting her rejections of independent claims 1, 22, and 25, however, the Examiner does not specifically comment on the claimed limit of "the current collector (30) [having] a sensible heat less than a sensible heat of the end cell (12)", as claimed in independent claims 1 and 25, and as essentially claimed in independent claim 22. The Examiner does, however, make specific observations on "sensible

heat" at page 18, stating "Applicant argues with respect to claim 2-5... that the properties [of sensible heat] of the current collector are patentable weight. [New para.] Examiner holds the position that these properties are inherent in the materials of the prior art and there is no evidence showing otherwise."

Attached hereto as Exhibit A, is a Declaration of a joint inventor Richard D. Breault, that specifically addresses at paragraphs 8 and 9 the Examiner's above conclusion on the claimed sensible heat of the current collector being an inherent property of the materials disclosed in the prior art. In essence the Declarant states that "sensible heat" necessarily includes both "specific heat" as an inherent characteristic of a material combined with a "design feature" of the mass of an object which is a function of the product of the width multiplied by height multiplied by thickness multiplied by density. Each independent claim requires that design features of the current collector be selected so that the sensible heat of the current collector is "less than the sensible heat of the end cell (12)". This necessarily requires measurement of the sensible heat of the end cell 12.

Nothing in Morrow or any known prior art requires these claimed characteristics. Because the Declarant has established in the Declaration that he is one of ordinary skill in the art through his vast experience in fuel cells, it is submitted that the attached Declaration is evidence establishing that the claimed properties of independent claims 1, 22, and 25 are not inherent in the materials of the prior art.

In addition, it is urged that it is improper to apply the theory of inherency to the materials disclosed in Morrow and other cited prior art to show or suggest the claimed components of independent claims 1, 22 and 25. "'In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.'" (Manual of Patent Examining Procedure (MPEP) at Section 2112 IV, quoting, Ex parte Levy, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) (emphasis in the original))

While the Examiner has provided detailed analysis through her many pages of her Second Office Action, the facts in particular of Morrow contrast markedly with evidence presented in the above referenced application regarding the required characteristics necessary to produce the claimed sensible heat of the current collector. At column 5, lines 50-51 of Morrow, a current collector of Morrow is described in an alternative embodiment as "a thin, conductive metal layer 39 [that] could be any highly conductive metal such as copper,...". At column 1, lines 64-65, Morrow also states that a "steel pressure plate may also serve as a current collector." Hence, Morrow teaches that materials that may be used to form a current collector include both copper and steel, or "any highly conductive metal".

In contrast the graph of Figure 5 of the present application entitled "SENSIBLE HEAT OF CURRENT COLLECTORS AS PRECENTAGE OF SENSIBLE HEAT OF ONE FUEL CELL" provides evidence that a current collector made of "304 or 316 stainless steel"

would have a sensible heat in excess of 110 percent of a sensible heat of one fuel cell, which would therefore be outside the claimed limits of independent claims 1, 22 and 25. In addition, Figure 5 also shows that carbon steels would have a sensible heat in excess of 25 percent of a sensible heat of one fuel cell which would be beyond the claimed limits of dependent claim 3. To establish the data presented in the above referenced application, the inventors had to determine the sensible heat of one fuel cell and compare it to the sensible heat of materials having adequate thickness for effective operation as a current collector within a fuel cell. Further evidence supporting the distinctive, required, claimed characteristics of the current collector of Applicants' fuel cell stack are disclosed in Figure 4 and the discussions of Figures 4 and 5 at page 14 of the specification. Again, nothing in Morrow or any known prior art shows the necessary integration of such operational characteristics of fuel cells with properties of materials to produce the limitations of the current collectors claimed in independent claims 1, 22, and 25.

The undersigned appreciates that the Examiner has presented a lot of detail in her Second Office Action regarding dimensional limitations of the claimed current collector and insulator, in particular with respect to the well-known assertion that: "it has been held that when the difference between a claimed invention and the prior art is the range or value of a particular variable, then a prima facie rejection is properly established when the difference in the range or value is small." (Second Office Action at page 5.) However, the dimensional limitations in the present claimed invention cannot

be measured in isolation as against other known thicknesses, etc., because the claimed dimensions of the current collector are in association with the "sensible heat", which in turn is a value dependent upon the sensible heat of the "end cell (12)".

Applicants further stress that application of the theory of inherency is especially inappropriate for the present claimed invention. Recently the Board of Patent Appeals and Interferences made a ruling remarkably on point. In Ex parte Schricker, 56 USPQ2d 1723, 1725 (B.P.A.I. 2000) (unpublished), the Board observed: "Inherency and obviousness are somewhat like oil and water - they do not mix well. Claimed subject matter can be unpatentable for obviousness when, notwithstanding a difference between that subject matter and a prior art reference, the claimed subject matter, as a whole, would have been obvious. However, when an examiner relies on inherency, it is incumbent on the examiner to point to the 'page and line' of the prior art which justifies an inherency theory." The Examiner has not, and the undersigned insists the Examiner cannot, point to any aspect of the prior art whatsoever that requires the claimed structural characteristics of the current collector wherein the "sensible heat" of the current collector must be "less than a sensible heat of the end cell (12)", as required by Applicants' independent claims.

Therefore, because the claimed limit of the sensible heat of the current collector is neither shown nor suggested in the prior art, it is respectfully requested that the Examiner remove her rejections of independent claims 1, 22, and 25 under 35 U.S.C. Sec. 103(a).

Next, the Examiner at the bottom of page 4 and top of page 5 in Section 3 has further supported her rejections of the independent claims 1, 22 and 25 under 35 U.S.C. Sec. 103(a) by insisting that the insulator claimed therein is also shown in Morrow, as follows: "Morrow et al. also teaches an insulator [36], which is placed next to the current collector (column 5, lines 27-28). Further, regarding the insulator, Morrow et al. teaches its purpose, which is restricting of heat from the fuel stack through the current collectors (column 5, lines 35 - 38). Therefore, it is inherent that total heat across the insulator from the end cell [is] no greater than the heat generated by the end cell." (Second Office Action at pages 4 - 5. Emphasis added.) At page 19 of the Second Office Action, in Section 6 "Response to Arguments", the Examiner makes the same statement, and then adds: "Additionally, the insulator cannot transmit more heat than is generated by the end cell, as it does not generate heat itself to transfer."

In the Exhibit A Declaration, the Declarant responds to these statements of the Examiner at paragraphs 3 - 7. In essence, the Declarant points out that according to Fourier's Law of thermal conduction, total heat flux or heat movement across a material includes the thermal conductivity of the material multiplied by the temperature differential across the material and divided by the thickness of the material. While thermal conductivity of a material is an intrinsic characteristic, the claimed insulator also includes a thickness limit so that as a result of both of those factors "the heat conduction across the insulator is less than the heat generated by the end cell".

As with the above discussion of "sensible heat", the determination of thermal conductivity and thickness must necessarily be compared to the measured heat generated by the end cell. Nothing in Morrow or any known prior art requires a comparison of the thermal conductivity of an insulator to heat generated by an adjacent fuel cell. Applicants insist that the attached Declaration successfully refutes the position of the Examiner that the claimed characteristics of the insulator are inherent from the Morrow insulator.

The Declarant in Exhibit A also addresses the Examiner's contention that: "the insulator cannot transmit more heat than is generated by the end cell, as it does not generate heat itself to transfer." (Second Office Action at page 19.) The Declarant points out that: "in the specification of the application at page 13, lines 9 - 12, it is stated that: 'It is known that during a 'bootstrap' start up, the fuel cells 14, 16, 18 that are not in contact with the current collector 30 quickly rise in temperature compared to the end cell 12 of the stack 10.' That is in part because the interior fuel cells 14, 16, 18 are adjacent each other, while one surface of the end cell is not adjacent a heat generating fuel cell, and instead is adjacent the current collector. One skilled in the art as I am realizes that a typical fuel cell stack may contain several hundred fuel cells. During such a 'bootstrap' start up, a temperature of fuel cells in the center of the stack increases more quickly than that of end cells. Therefore, it is possible for several fuel cells near an end of the fuel cell stack to lose heat to a prior art pressure plate so that a total rate of heat transfer across an insulator could be greater than the heat

generated by an end cell of such a fuel cell stack."

This is compelling evidence that refutes the position of the Examiner on the aforesaid point, and thereby further supports the conclusion that the insulator claimed in independent claims 1, 22, and 25, and defined with even narrower limits in dependent claims 4 - 6, 8 - 10, is neither shown nor suggested in Morrow or other know prior art.

Additionally, Applicants incorporate herein by reference thereto their above arguments that the theory of inherency is improperly applied not just to the Examiner's conclusion in holding the claimed properties of sensible heat of the current collector to be inherent from the materials of the prior art, but also that the theory of inherency is improperly applied in concluding the claimed properties of the insulator are inherent from the insulator disclosed in Morrow. The undersigned feels it is not necessary to re-quote Section 2112 of the MPEP, or further authority cited above and for purposes of efficiency simply refers again to that discussion above. For similar reasons, however, the Applicants insist that nothing in Morrow or known prior art shows or suggests, as recited in detail in the attached Exhibit A Declaration, a fuel cell stack wherein an insulator necessarily includes both specific thermal conductivity and thickness properties selected relative to heat generation in a single end cell.

Therefore, for this separate reason it is respectfully requested that the Examiner remove her rejection of independent claims 1, 22 and 25 because the known prior art does not include

the limitations of the claimed insulator of claims 1, 22 and 25. "To establish *prima facie* obviousness of a claimed invention, all the claimed limitations must be taught or suggested by the prior art." (MPEP, Sec. 2143.03) Additionally, because the dependent claims simply further limit the now allowable independent claims 1, 22, 25, it is respectfully requested that the Examiner also remove her rejections under 35 U.S.C. Sec. 103(a) of the remaining dependent claims. "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." (Id.)

In addition, claims 22 and 25 have been amended to correct minor typographical errors.

III. Conclusion

By the present amendments to claims 23 and 24, and by the argument presented above it is respectfully urged that all of the Examiner's concerns raised in the Second Office Action have been resolved. Accordingly, it is respectfully requested that the Examiner remove the rejections of the pending claims, and issue a Notice of Allowance.

Respectfully submitted,
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Date: 6/15/07